

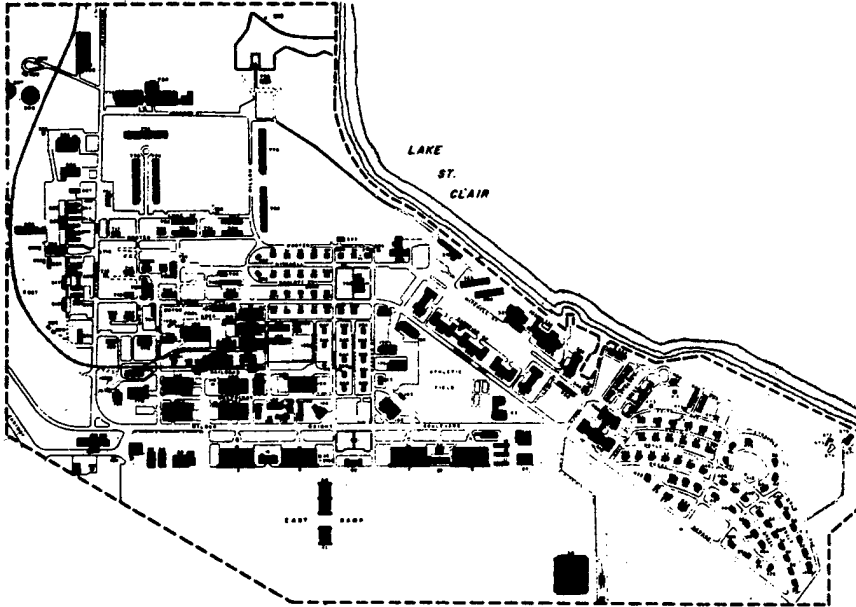
ENERGY ENGINEERING ANALYSIS PROGRAM

FINAL REPORT — INCREMENTS A, B, F AND G

VOLUME 1 — EXECUTIVE SUMMARY

U. S. ARMY

SELFRIDGE AIR NATIONAL GUARD BASE, MICHIGAN



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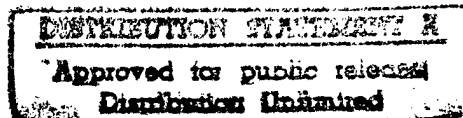
U. S. ARMY CORPS OF ENGINEERS
OMAHA DISTRICT

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PROJECT A1-30-20

CONTRACT NO. DACA45-80-C-0091

December 1983



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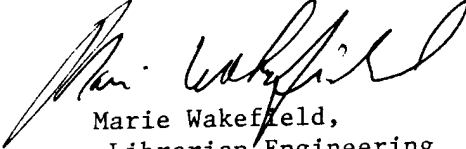


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FINAL REPORT
VOLUME 1 - EXECUTIVE SUMMARY

ENERGY ENGINEERING ANALYSIS PROGRAM
INCREMENTS A, B, F AND G

SELFRIDGE ANG BASE
MT. CLEMENS, MICHIGAN

CONTRACT NO. DACA45-80-C-0091

Prepared by
GARD, INC.
Niles, Illinois 60648

For
Department of the Army
Corps of Engineers
Omaha District

December, 1983

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PREFACE

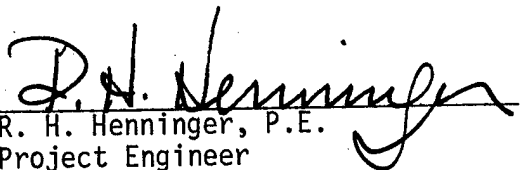
This Final Report summarizes work accomplished under Increments A, B, F and G of the Energy Engineering Analysis Program conducted for the U.S. Army Activity at Selfridge Air National Guard Base, Michigan. The tasks assigned under these Increments have been completed and are documented within.

The study objective was to develop a systematic plan of projects that would result in the reduction of energy consumption in compliance with the Army Facilities Energy Plan (AFEP) and to prepare Project Development Brochures (PDB's), DD Forms 1391 and supporting documentation for those projects deemed feasible. The projects developed as a result of this study are described in this report. Project Development Brochures and DD Forms 1391 have been prepared in accordance with Army procedures and are bound separately.

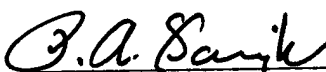
GARD has sincerely appreciated the cooperation that has been extended by members of the Omaha District, Corps of Engineers especially the Program Managers, Mr. S. Owens and Mr. E. Liu, and the U.S. Army Contracting Officer Representative (COR) at SANGB, Mr. F. Braun.

The GARD project team that conducted this study include M. Hormann, K. Spaulding, R. Hedrick, C. Schafer, N. Leslie and M. Hagen.

Respectfully submitted,


R. H. Henninger, P.E.
Project Engineer

Approved by:


P. A. Saigh, P.E.
Director, Government Programs

ADDENDUM TO THE FINAL REPORT

In response to revised ECIP Guidance issued 12/31/82, the Omaha District, Corps of Engineers has reviewed and revised all of the ECIP calculations for each of the qualifying projects identified for Selfridge Air National Guard Base. Appropriate changes have been made in pertinent sections of the DD Forms 1391 and Project Development Brochures only. There is one ECO, Upgrade Window Systems of Building 400, which does not qualify for funding when evaluated under the new ECIP guidelines. The Main Report has not been revised to include these changes.

EXECUTIVE SUMMARY
ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)
INCREMENTS A, B, F AND G
U.S. ARMY ACTIVITY
SELFRIDGE ANG BASE, MICHIGAN

Authorization for Study

This Energy Engineering Analysis Program (EEAP) for the U.S. Army Activity at Selfridge ANG Base, Michigan (SANGB) was conducted under Contract No. DACA45-80-C-0091 issued by the Omaha District, Corps of Engineers to GARD, INC., Niles, Illinois on 13 August 1980. The scope of work is structured into work increments with Increments A and B authorized under the original contract, Increment G authorized under Modification 1 dated 3 March 1981 and Increments B (expanded EMCS) and F authorized under Modification 2 dated 20 May 1982.

Objectives and Scope

The overall objectives of the EEAP are:

- a) "Develop a systematic plan of projects that will result in the reduction of installation energy consumption in compliance with the Army Facilities Energy Plan (AFEP)."
- b) "Develop Coordinated Basewide Energy Systems Plans."
- c) "Prepare Project Development Brochures (PDBs), DD Forms 1391 and supporting documentation for all feasible energy conservation projects."

The EEAP scope of work is divided into seven (7) increments which include the following:

Increment A - ECIP* Projects for Buildings and Processes

Increment B - ECIP Projects for Utilities, Energy Distribution Systems
and Energy Monitoring and Control Systems (EMCS)

* ECIP - Energy Conservation Investment Program

- Increment C - Renewable Energy Systems Projects
- Increment D - Cogeneration and Solid Waste Plants Projects
- Increment E - Central Boiler Plant Projects
- Increment F - Facilities Engineer Conservation Measures
- Increment G - Projects Identified in Increments A and B that do not qualify under ECIP criteria.

This submittal presents the final results of Increments A, B, F and G through a description of those energy conservation opportunities (ECOs) and ECIP projects that were identified and evaluated as part of these work increments. Increments C, D and E have not been authorized at this time for Selfridge Air National Guard Base.

Approach

Numerous retrofit modifications referred to as energy conservation opportunities (ECOs) were identified for each building, system and central plant studied. Each ECO was evaluated separately using the life cycle costing methods described in the ECIP guidance included as Annex F of the AFEP. Energy savings were determined for each ECO and life cycle benefits were calculated using current mid FY82 fuel costs, which were escalated over the expected life of the modification. Implementation or construction costs were also determined using current FY82 cost data which were escalated to the midpoint of construction assuming an FY86 project award date. Comparison of ECOs was done on the basis of energy-to-cost (E/C), benefit-to-cost (B/C), and simple amortization period (SAP) ratios in accordance with ECIP criteria. Qualifying ECOs were grouped into ECIP projects under the guidance of the

U.S. Army COR at SANGB. Then, once adjustments were made for any interactive or synergistic ECO effects which were present within an ECIP project, the PDB and DD Form 1391 were prepared for each ECIP project. Non-qualifying ECOs became candidates for implementation as an Increment G project.

Facility Description

The Selfridge Air National Guard (SANG) Base is located on Lake St. Clair 30 miles northeast of Detroit, near Mt. Clemens, Michigan. The Michigan Air National Guard serves as the host agent with several other government agencies occupying numerous buildings as tenants, including the U.S. Army.

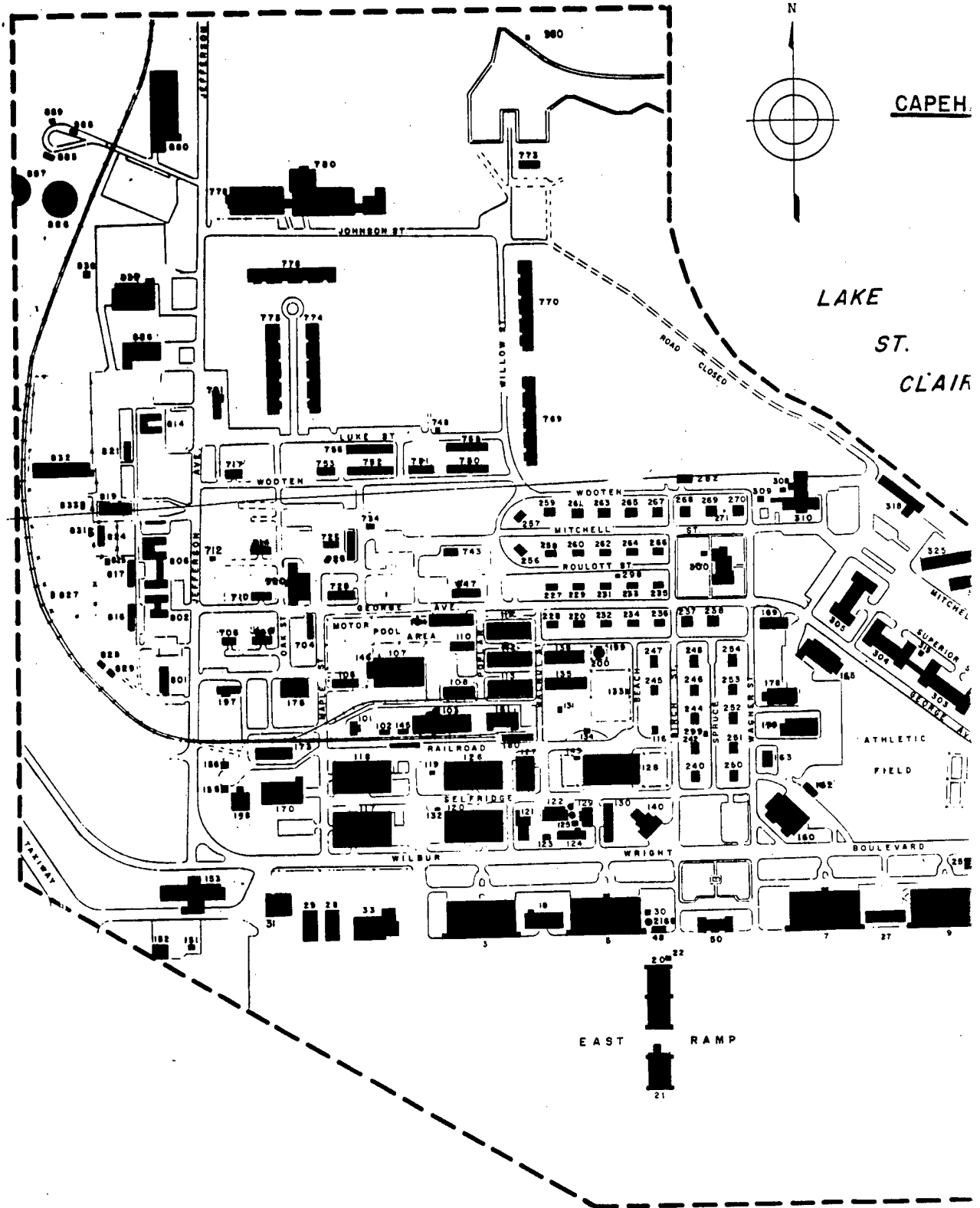
The U.S. Army Tank-Automotive Materiel Readiness Command Support Activity-Selfridge (TARCOMSA-S), is headquartered at Selfridge ANG Base and provides support services for military personnel of all services in the southeastern Michigan area. This includes housing for 1,033 families, the Facilities Engineering support of all housing units, and certain industrial, morale, subsistence and recreational facilities.

All facilities engineering responsibilities are now handled by a contractor, Serv-Air, Inc. The U.S. Army Contract Officer Representative stationed at the Base monitors Serv-Air activities. The Base currently covers 3,629 acres including Capehart, a 70 acre housing area located 3 miles north of the Base. The bulk of the area is occupied by the Air Base runways and associated hangars and support buildings. Figure 1a shows the plot plan of Selfridge ANG Base. The Cantonment Area and Capehart Family Housing Area are shown separately in Figure 1b.

According to a Facility Listing dated 10 September 1979, the number of buildings assigned to the Army at Selfridge ANG Base totals over 600 (see Table 1) with a gross occupied floor area of over 1.7 million square feet.

Figure 1a SELFRIDGE SITE PLAN

BASE LAYOUT



①

Figure 1b SELFRIDGE AIR NATIONAL GUARD BASE
SITE PLAN - CANTONMENT AREA AND
CAPEHART HOUSING AREA

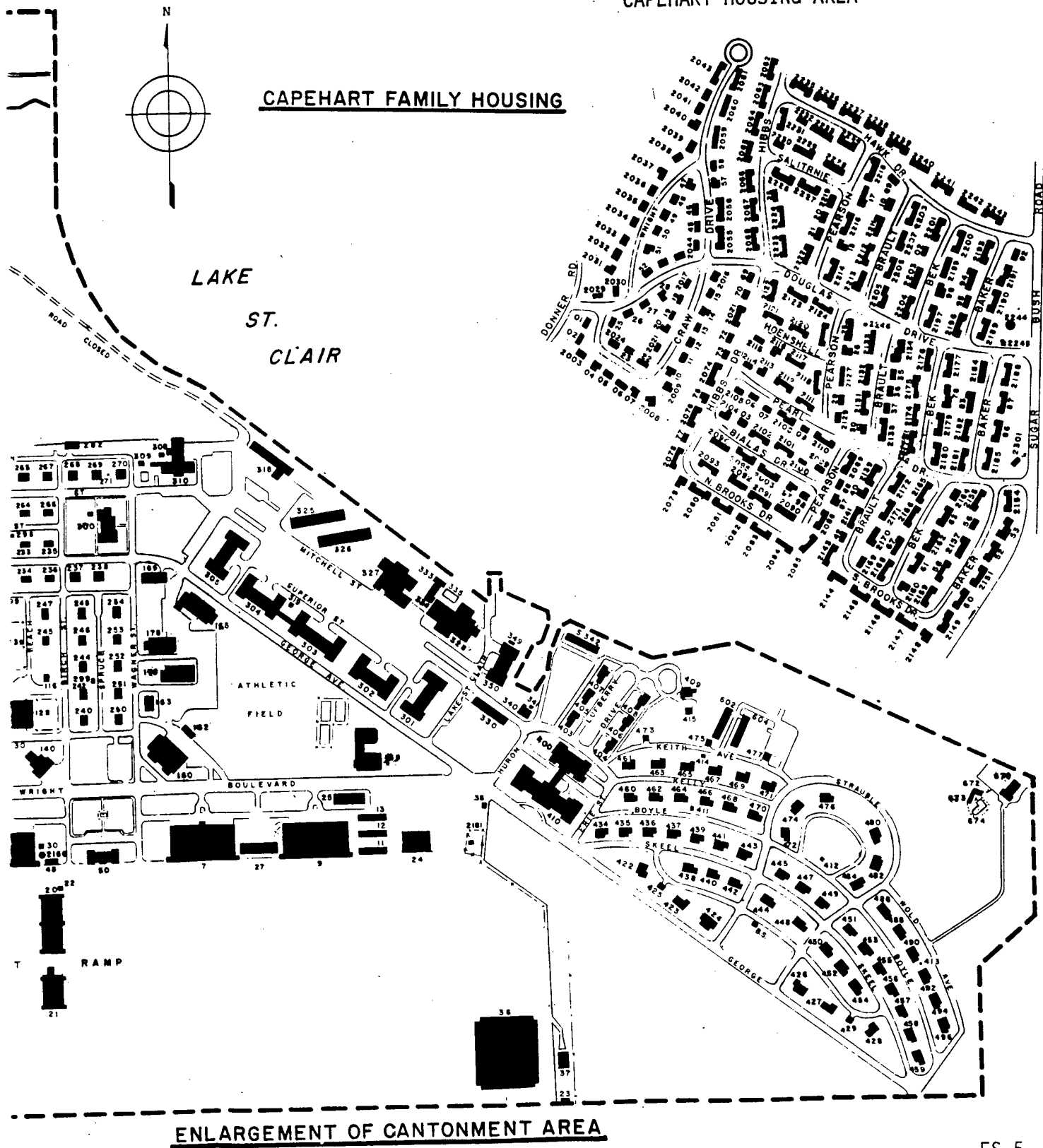


TABLE 1
SUMMARY OF BUILDINGS ASSIGNED TO TARCOMSA-S
AT SELFRIDGE ANG BASE

Classification	Number of Buildings	Number of Dwelling Units	Gross Square Feet
Commercial/Industrial	88	-	407,276
Housing			
200 Area	39	78	97,884
400 Area	62	62	173,917
500 Area	2	2	6,877
700 Area	5	40	59,320
900 Area *	29	471	499,884
Capehart	<u>380</u>	<u>380</u>	<u>~ 500,000</u>
	605	1,033	1,745,158

* Building 937 containing 18 dwelling units was damaged by fire and is not included

The buildings range in size from 37 sq.ft. to 34,224 sq.ft., the largest being Building 970.

A total of 57 buildings occupied by the U.S. Army at Selfridge ANG Base have been identified for study under this contract. Forty-four (44) of the designated buildings were commercial or industrial while the remaining 13 were sample dwelling units from the housing areas. The 44 commercial and industrial buildings totalling 347,234 sq.ft. (85% of the total commercial/industrial building area), constitute the majority of those Army buildings that are actively occupied. Table 2 summarizes the 57 buildings that are under study, listing their designated number, title, function, number of floors and gross square footage.

Energy Distribution Systems and Central Plants

Selfridge ANG Base uses four major forms of energy to support facility operations: electricity, coal, oil and natural gas. Electricity is used for lighting, heating, cooling, ventilation, security, etc. systems. Coal, oil and gas are used by several central heating plants to generate steam or hot water used for heating many of the buildings. Oil and gas are also used as a source of heating for those buildings that have their own heating plants. The site energy distribution systems and central plants which use and distribute these forms of energy are summarized in Table 3.

Energy Conservations Actions Since FY75

Significant progress has been made by TARCOMSA personnel in reducing energy usage. This has resulted from implementation of numerous energy conservation projects over the last several years. The list below summarizes the facility-related energy conservation modifications that have been performed since FY75.

TABLE 2
SUMMARY OF SELFRIDGE ANG BASE
BUILDINGS DESIGNATED FOR STUDY

Building No.	Title	Function	No. of Floors	Gross Sq.Ft.
<u>Commercial/Industrial Buildings</u>				
103	Commissary Warehouse	Storage	1	10,054
104	Wood & Auto Shop	Institutional	1	6,600
111	Commissary Storage	Storage	1	9,266
112	Exchange Warehouse	Storage	1	9,266
160	Main Exchange Store	Institutional	1	11,014
162	Main Exchange Service Outlet	Institutional	1	3,093
165	Base Gymnasium	Institutional	1	14,384
168	Base Chapel	Institutional	1	12,198
169	Base Library	Institutional	1	3,690
179	Base Theater	Institutional	1	9,202
181	Commissary Cold Storage	Special	1	6,926
300	NCO Open Mess	Institutional	1	9,628
310	Base Clinic	Institutional	3	27,000
328	Recreation Center	Institutional	2	18,361
334	Pump House	Utility	-	227
400	Officers Open Mess	Institutional	1	10,170
535	Emergency Ordnance Disposal	Service	1	2,194
599	Golf Course Clubhouse	Institutional	1	5,250
670	Recreation Building	Institutional	1	3,331
673	Pump House	Utility	-	236
707	Criminal Investigation	Administration	1	1,843
714	Thrift Shop	Institutional	1	1,843
717	Exchange Offices	Administration	1	1,543
720	Base Exchange	Institutional	1	9,046
726	Supply & Equipment Storage	Storage	1	4,566
747	Barber Shop	Institutional	1	2,750
750	Barracks	Housing	2	9,440

TABLE 2 (Con't.)
SUMMARY OF SELFRIDGE ANG BASE
BUILDINGS DESIGNATED FOR STUDY

Building No.	Title	Function	No. of* Floors	Gross * Sq.Ft.
751	Commissary Offices	Administration	1	2,650
758	Barracks	Housing	2	9,440
781	Service Station	Institutional	1	3,410
826	Bowling Center	Institutional	2	8,889
835	Commissary	Institutional	1	11,212
951	Child Care Center	Institutional	1	3,374
970	Administration Offices	Administration	2	34,224
1492	Vehicle Maintenance Shop	Service	2	30,325
1493	Pump House	Utility	-	178
1505	Wood Shop	Institutional	1	5,958
1506	Offices	Administration	1	7,750
1515	Education Center	Institutional	1	9,338
1516	Offices	Administration	1	7,103
1519	Boiler House	Utility	1	1,487
1522	Warehouse	Storage	1	4,571
1533	Vehicle Garage	Service	1	2,160
1669	Golf Clubhouse Storage	Storage	1	2,044
			SUBTOTAL	347,234
<u>Housing</u>				
200 Area (2 Units)		Housing	2	2,686 & 4,268
400 Area (4 Units)		Housing	2	3,246 each
500 Area (1 Unit)		Housing	2	2,260
700 Area (1 Unit)		Housing	2	12,048
900 Area (2 Units)		Housing	1	775 & 1,175
Capehart Area (3 Units)		Housing	1	1,255 each
			SUBTOTAL	39,961
			TOTAL	387,195

* For Housing, Basement and Mechanical Rooms are included

TABLE 3
SELFRIDGE AIR NATIONAL GUARD BASE
DISTRIBUTION SYSTEMS AND CENTRAL PLANTS

Energy Form	Source	Distribution System	End User
Electricity	Detroit Edison Co. via Michigan ANG	2 Primary Feeders @ 40KV aerial lines	Main Substation, Bldg. 855
		2 Secondary Feeders @ 4.8KV	Specific Loads (Bldgs., Perimeter Lighting, Tenants) Capehart Housing
		1 Secondary Feeder @ 13.2KV	
		3 Primary Feeders @ 4.8KV	1500 Area Buildings and Building 535
Electricity	Detroit Edison		
Natural Gas	Consumers Power Co. via Michigan ANG	Underground Pipes	Cantonment Area and 900 Area Buildings
Steam	Michigan ANG via Bldg. 327 Central Heating Plant Capacity: (2) 4190 KBH gas fired boilers	Buried Pipes @ 110 psi	East Cantonment Area
Steam	Michigan ANG via Bldg. 122 Central Heating Plant Capacity: (6) 4693 KBH coal fired boilers	Buried Pipes @ 7 psi	Southwest Cantonment Area
Hot Water	Building 1519 Central Heating Plant Capacity: (1) 4250 KBH oil fired boiler	Buried Pipes	Buildings 1505, 1506, 1515 and 1519
Hot Water	Building 1493 Central Heating Plant Capacity: (1) 540 KBH oil fired boiler	Buried Pipes	Building 1492 Fire Protection
Fuel Oil	Outside Vendors	Building Storage Tanks	Various Buildings

- All thermostats for heating, air conditioning and hot water systems were reset in accordance with Army standards.
- Delamping was performed in stairwells, corridors, and aisleways of all administration and support buildings.
- Several buildings have been vacated, shutdown and operations consolidated into other buildings.
- Roof and ceiling insulation has been installed in dwelling units in the 200, 400, 500, 700 and 900 housing areas (753 homes).
- Windows in the 200 housing area (78 dwelling units) have been replaced with new air tight windows and storm windows. New storm doors were also installed.
- New gas-fired hot water boilers have been installed in 7 buildings in 200 housing area.
- New gas-fired hot water boilers have been installed in 6 buildings in 400 housing area.
- In the 900 housing area, 100 gas-fired, forced hot air furnaces have been installed. New windows with storms and new storm doors have also been installed in all units.
- Thermostatic radiator valves have been installed on perimeter heating system of Building 970.

Historical Energy Data

Each month the Army, being a tenant at Selfridge ANG Base, is billed for utility usage by the Michigan ANG. Additional bills for electricity supplied directly to Army operated buildings are received from Detroit Edison. Fuel oil supplied by private contractors is also billed directly to the Army. Figure 2 depicts schematically the various uses that each energy source is

PURCHASED UTILITIES

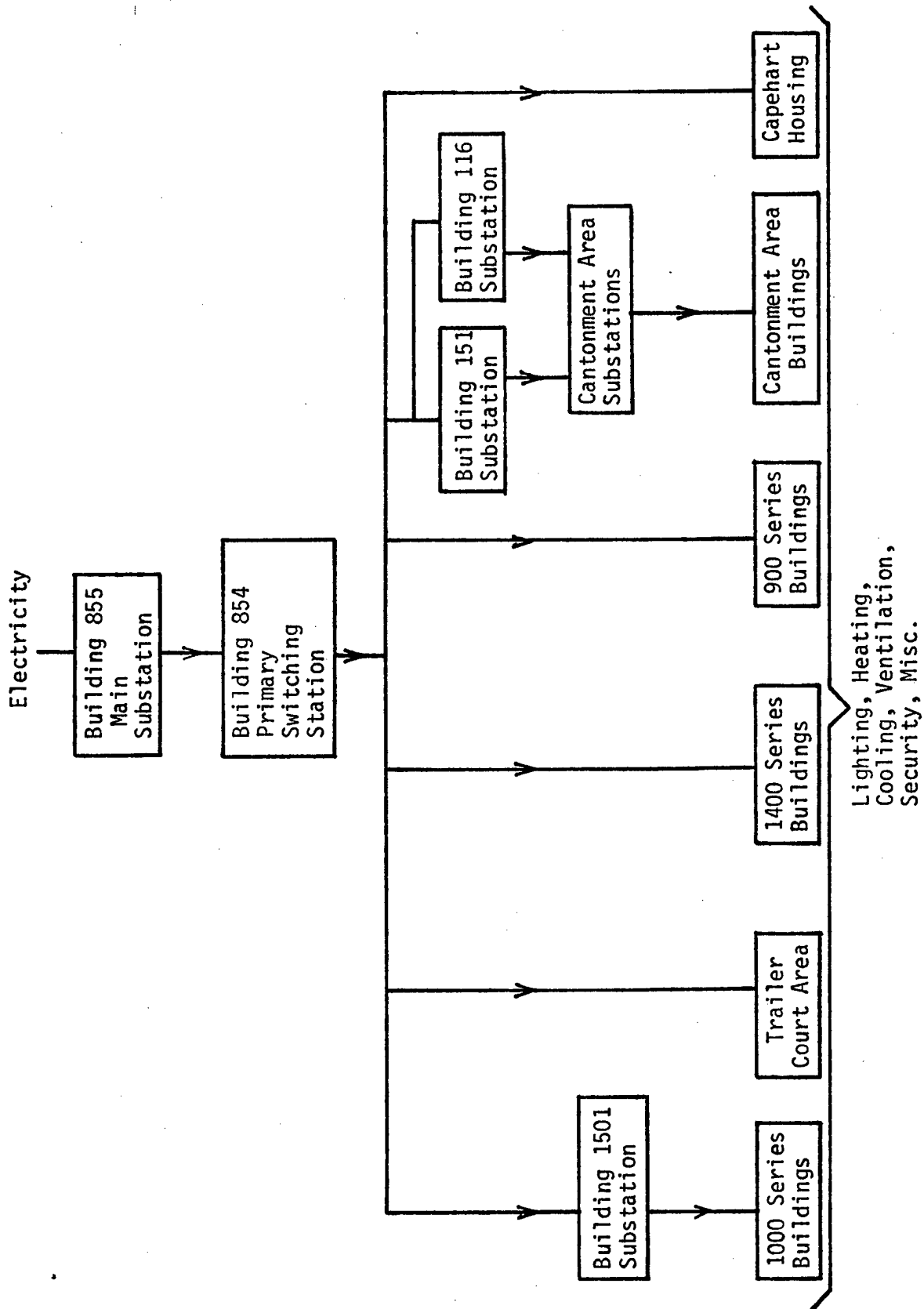


Figure 2 SELFRRIDGE AIR NATIONAL GUARD BASE UTILITIES USAGE DIAGRAM

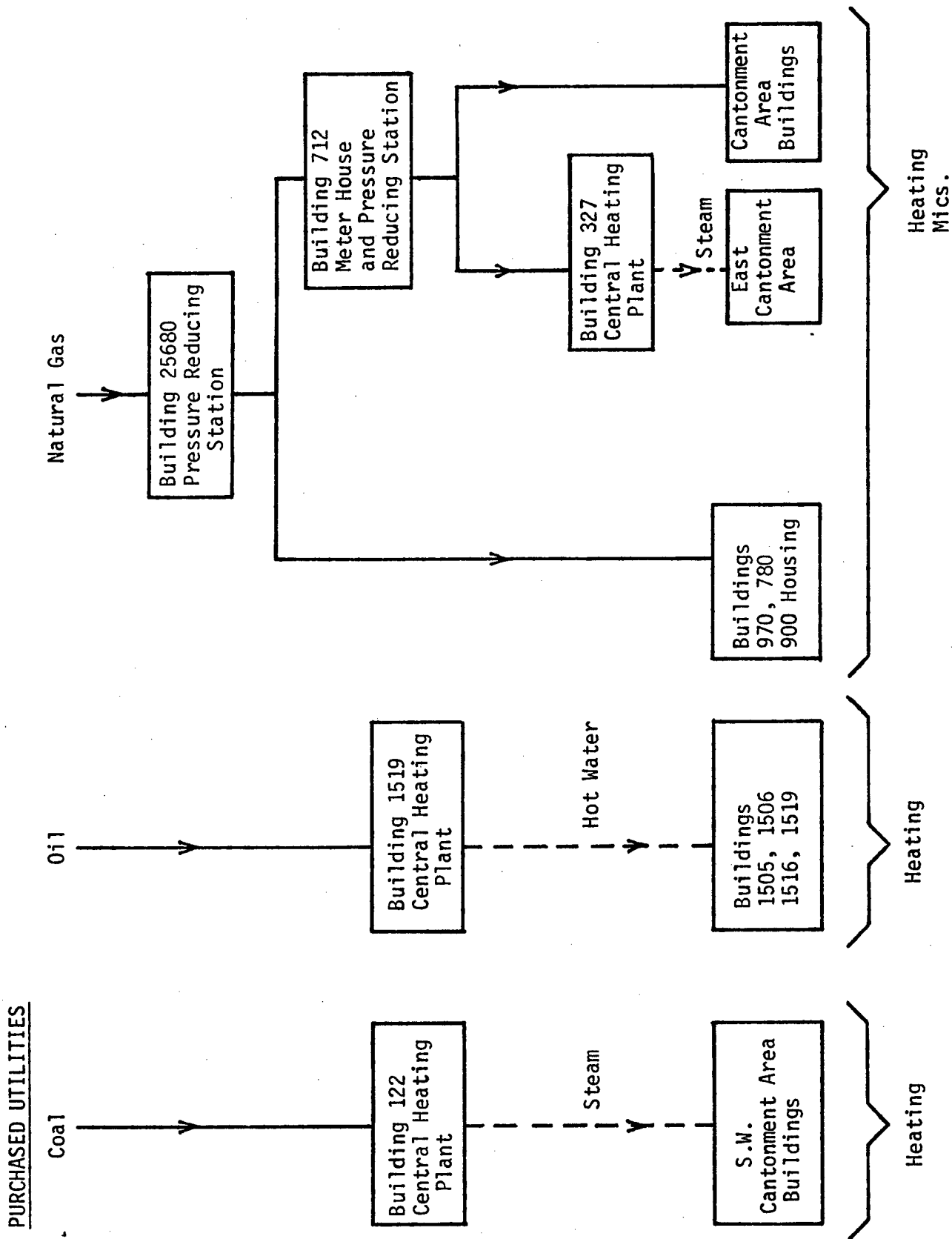


Figure 2 (Con't.) SELFRIDGE AIR NATIONAL GUARD BASE UTILITIES USAGE DIAGRAM

put to. Since electricity and natural gas are not submetered, the Michigan ANG uses empirical algorithms based upon occupied square footage and type of building to estimate the monthly utility usage for each of the tenants. These algorithms were originally supplied by the Detroit Edison Company and Consumers Power Company back in 1971. Occasionally, portable recording meters are used to verify and adjust electricity estimates. Electricity usage for residences is estimated on the basis of occupancy levels using the total number of occupants and the number of occupied units. Electricity for Capehart is separately metered. Natural gas usage for the Wherry Housing is metered separately while the Other Public Quarters (OPQ) gas consumption is based on number and type of appliances, e.g., stoves, dryers, hot water heaters, etc. Gas used for space heating is again estimated by building size and usage. Fuel oil is billed based upon the actual number of gallons delivered.

Total annual facility-related energy consumption for the years FY79 and FY80 are shown in Figure 3 in terms of source energy requirements. Figure 4 presents a comparison for FY80 of relative energy usage by type of utility billed. Using FY79 as a base year, the annual comparative results (see Table 4) indicate a substantial reduction in total energy usage for FY80. The energy consumed in FY81 was virtually unchanged from FY80.

Table 5 breaks out the total annual energy usage into its residential and industrial energy usage components. The residential component is further broken down into the three basic residential areas, i.e., Capehart, Wherry, and Other Public Quarters, OPQ. The residential energy usage indicates a general trend of conservation. Residential energy usage is approximately twice the industrial energy usage.

Actual costs for the billed utilities were obtained from Selfridge ANG

Monthly Energy Consumption (10⁶ BTU)

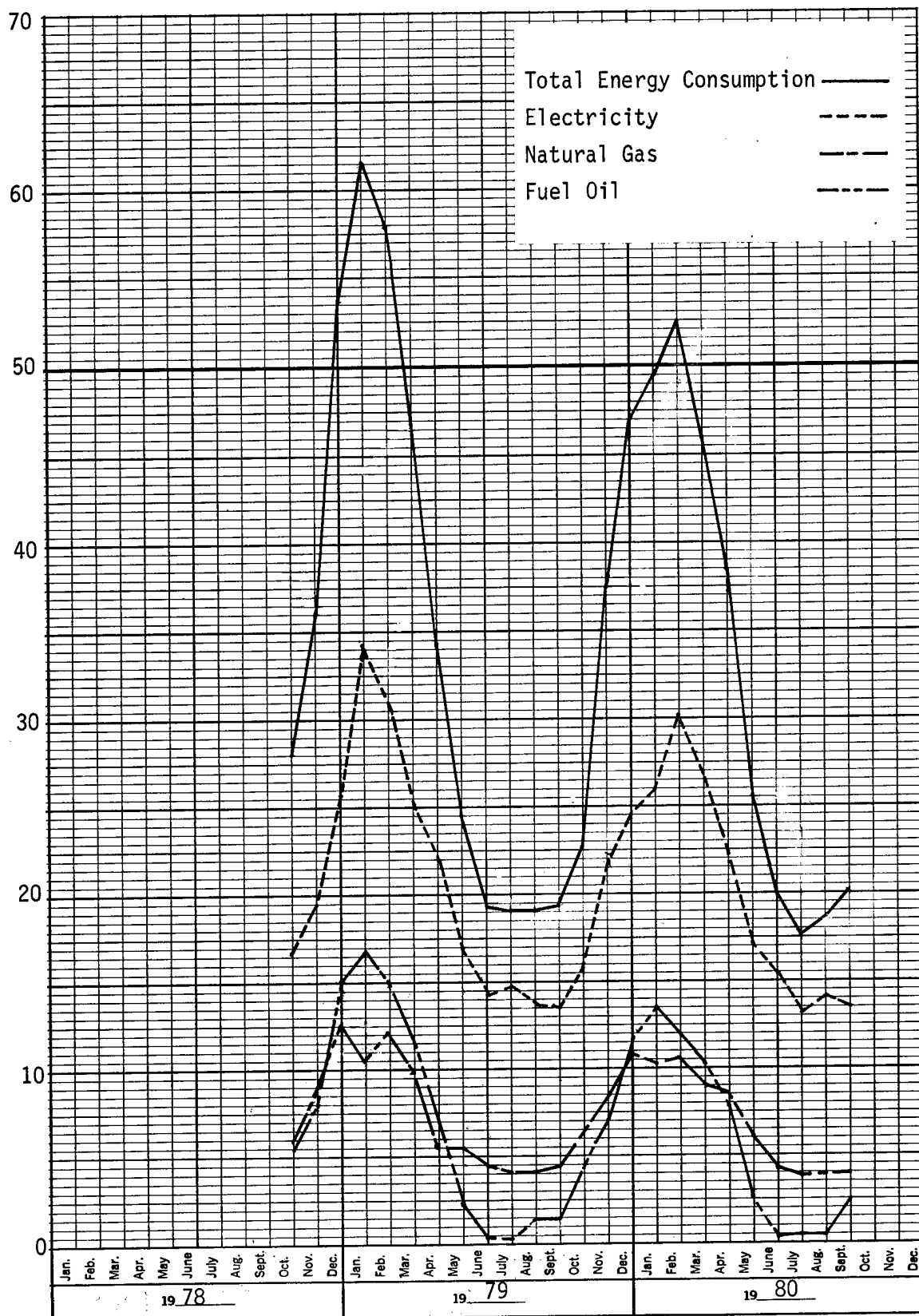


Figure 3 TARCOMSA HISTORICAL SOURCE ENERGY CONSUMPTION AT SELFRIDGE ANG BASE

Billed Utilities FY80 Consumption (MBTU)

Electricity 240,804

Natural Gas 82,328

Fuel Oil 72,989

396,121

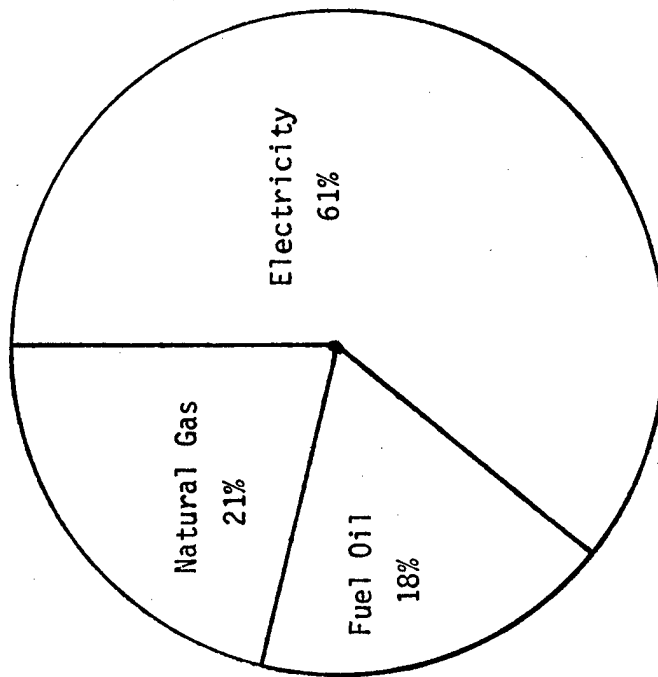


Figure 4 SELFRIDGE AIR NATIONAL GUARD BASE RELATIVE ENERGY USAGE BY UTILITY

TABLE 4
COMPARISON¹ OF TOTAL ANNUAL ENERGY CONSUMPTION
FOR TARCOMSA OCCUPIED BUILDINGS AT SELFRIIDGE ANG BASE

Reporting Period	Electricity MBTU % Change	Natural Gas MBTU % Change	Fuel Oil MBTU % Change	Total MBTU % Change	Total Energy Usage Index ² KBTU/SQ.FT.
FY79	247,787 -	87,402 -	84,763 -	419,955 -	250.3
FY80	240,804 -2.8	82,328 -5.8	72,989 -13.9	396,121 -5.7	236.0
FY81	240,080 -3.1	82,350 -5.8	72,591 -14.4	395,021 -5.9	235.4

¹FY79 is used as a base year

²Assuming 1,678,022 total square feet including 97% occupancy of residential units

TABLE 5
BREAKDOWN OF ANNUAL ENERGY USAGE
FOR TARCOMSA OCCUPIED BUILDINGS AT
SELFRIIDGE ANG BASE

Reporting Period	Location	Electricity ¹ MBTU	Natural Gas MBTU	Fuel Oil MBTU	Total MBTU	Total % Change ³	Total Energy ² Usage Index KBTU/SQ. FT.
FY79	Capehart	149,695	-	-	149,695	-	299.4
	Wherry	24,838	53,174	-	78,012	-	156.1
	OPQ	18,758	9,164	43,690	71,612	-	211.9
	Total Residential	193,338	62,338	43,690	299,319	-	174.2
	Industrial	52,827	25,064	41,073	118,964	-	312.8
FY80	Capehart	141,722	-	-	141,722	-5.3	283.4
	Wherry	25,103	51,560	-	76,663	-1.7	153.4
	OPQ	19,169	9,164	39,226	67,559	-5.7	199.9
	Total Residential	185,994	60,724	39,226	285,944	-4.5	166.4
	Industrial	54,384	21,604	33,763	109,751	-7.7	288.6
FY81	Capehart	143,265	-	-	143,265	-4.3	286.5
	Wherry	24,533	50,156	-	74,689	-4.3	149.4
	OPQ	19,285	9,164	39,632	68,081	-4.9	201.4
	Total Residential	183,683	59,320	39,632	282,635	-5.6	164.5
	Industrial	52,688	23,030	32,959	108,677	-8.6	285.8

¹Electricity used by the trailer park is assumed negligible

²97% occupancy in residential areas

³FY79 is used as a base year

utility spread sheets and results for the periods FY79 through FY81 were compiled and are presented in Tables 6 through 8. Dramatic increases in the unit costs for all forms of energy have been experienced, even over a two year period. Fuel oil costs have increased the fastest, FY81 costs increasing to 2½ times the FY79 costs. The combined effect of these increases can be seen in Table 9 where annual operating costs due to utilities are summarized on a per square foot basis.

Building Energy Consumption Analysis

Little in the way of utility submetering of individual buildings occupied by the Army is done at Selfridge ANG Base. Establishing annual energy usage rates for the buildings under study was done, therefore, using various analytical methods.

Table 10 compares the annual electrical consumption estimates to historical data for the five groups of buildings (see Main Report for details). Estimates for groups of residential buildings are generally within 18%, with some of the difference probably accounted for by line distribution losses. The group of buildings for which the Army is billed directly by Detroit Edison includes some buildings which are not under study, and hence the reason for some of the disagreement. The remaining buildings are supplied from the Michigan Air National Guard network with charges billed under the U.S. Army Facilities Support Detachment Agreement 25 FB 6221-1003-7. This agreement was originally written in December 1971 and has undergone only minor revisions since that time. The comparison shown in Table 10 gives some indication that this agreement should be re-evaluated. The usage billed by MIANG is higher than the estimated consumption by a factor of 4, a much greater difference than for any other consumption category.

Estimated annual energy consumption for all types of energy are summarized

TABLE 6
SUMMARY OF
ELECTRICITY UTILITY COSTS
FOR TARCOMSA OCCUPIED BUILDINGS AT
SELFRIDGE ANG BASE
FY79 - FY81

Reporting Period	Usage KWH	Cost \$	Unit Cost		% Change ¹
			\$/KWH	\$/MBTU	
FY79	21,361,007	812,412	0.0380	3.279	-
FY80	20,759,353	866,269	0.0417	3.597	9.7
FY81	20,697,309	1,011,776	0.0489	4.214	28.5

¹ FY79 is compared as the base year

TABLE 7
SUMMARY OF
NATURAL GAS UTILITY COSTS
FOR TARCOMSA OCCUPIED BUILDINGS AT
SELFRIDGE ANG BASE
FY79 - FY81

Reporting Period	Usage Cubic Ft.	Cost \$	Unit Cost		% Change ¹
			\$/CF	\$/MBTU	
FY79	84,774,671	206,499	0.00244	2.363	-
FY80	79,852,159	206,303	0.00258	2.506	5.7
FY81	79,873,593	262,899	0.00329	3.192	35.1

¹ FY79 is compared as the base year

TABLE 8
SUMMARY OF
FUEL OIL UTILITY COSTS
FOR TARCOMSA OCCUPIED BUILDINGS AT
SELFRIDGE ANG BASE
FY79 - FY81

Reporting Period	Usage Gallons	Cost \$	Unit Cost		% Change ¹
			\$/GAL	\$/MBTU	
FY79	611,123	289,281	0.473	3.413	-
FY80	526,236	519,913	0.988	7.123	108.9
FY81	523,364	640,552	1.224	8.824	158.5

¹ FY79 is compared as the base year

TABLE 9
SUMMARY OF
TOTAL ANNUAL UTILITY COSTS
FOR TARCOMSA OCCUPIED BUILDINGS AT
SELFRIDGE ANG BASE
FY79 - FY81

Reporting Period	Usage MBTU	Cost \$	Unit Cost \$/MBTU	% Change ²	Estimated ¹
					Operating Cost \$/SQ.FT.
FY79	419,955	1,316,065	3.134	-	0.784
FY80	396,121	1,601,235	4.042	29.0	0.954
FY81	395,021	1,915,227	4.848	54.7	1.141

¹ Based upon 1,678,022 square feet including 97% occupancy of residential units

² FY79 is compared as the base year

TABLE 10
COMPARISON OF ESTIMATED ELECTRICAL CONSUMPTION
WITH ACTUAL BILLINGS FOR FY79 AND FY80

Account	Annual Consumption Estimate	Historical Data (Base Case)			
		FY80		FY79	
		Consumption Billed	% Diff.	Consumption Billed	% Diff.
Capehart	10,073,040	12,217,440	-17.6	12,904,680	-21.9
Wherry	1,903,648	2,163,974	-12.0	2,141,363	-11.1
OPQ	1,533,119	1,652,568	- 7.2	1,616,977	- 5.2
Detroit Edison	315,795	674,099 ¹	-53.2	760,412 ¹	-58.4
Michigan ANG	990,148	4,013,933 ¹	-75.3	3,793,625 ¹	-73.9

¹The buildings under this study account for most but not all of the buildings billed.

TABLE 11
ESTIMATED ANNUAL ENERGY CONSUMPTION SUMMARY
FOR TARCOMSA OCCUPIED BUILDINGS AT SELFRIDGE ANG BASE

BUILDING DESCRIPTION	FLOOR AREA (SQ FT)	ELECTRICITY (KWH)		NATURAL GAS (KCF)	FUEL OIL (GAL)	STEAM (KBTU)	TOTAL ENERGY (MBTU)	ENERGY USE INDEX (KBTU PER SQ FT)
		LIGHTING	EQUIP. COOLING					
103 - COMMISSARY WAREHOUSE	10054.	17644.			7795.4		1286.	127.9
104 - WOOD & AUTO SHOP	6600.	29930.	5844.	1200.4			1653.	250.4
111 - COMMISSARY STORAGE	9266.	18032.			9460.8		1521.	164.2
112 - EXCHANGE WAREHOUSE	9266.	17664.			10480.9		1659.	179.0
160 - MAIN EXCHANGE STORE	11014.	26265.	3852.			601714.	1720.	156.2
162 - MAIN EXCH. SERV. OUT.	3093.	15126.	1513.			218267.	594.	192.2
165 - BASE GYMNASIUM	14384.	71610.	6090.		13396.2		2759.	191.8
168 - BASE CHAPEL	11898.	46548.	2069.		7486.9		1602.	134.7
169 - BASE LIBRARY	3367.	19638.			3249.5		679.	201.5
179 - BASE THEATER	9202.	11076.			11405.6		1710.	185.9
181 - COMM. COLD STORAGE	6926.	3680.	44026.				553.	79.9
300 - NCO OPEN MESS	8699.	6975.	16400.		6272.5		1416.	162.8
328 - RECREATION CENTER	18361.	54064.				1045005.	1672.	91.1
334 - PUMP HOUSE	227.		4032.				47.	206.0
400 - OFFICERS OPEN MESS	10170.	40716.	19227.	350.6			1561.	153.4
535 - EMERG. ORD. DISPOSAL	2194.	4600.	2024.		3695.8		589.	268.7
599 - GOLF CLUBHOUSE	5250.	24084.	15792.		6983.1		1431.	272.6

1 KWH ELECTRICITY = 0.0116 MBTU
1 KCF NATURAL GAS = 1.031 MBTU
1 GAL FUEL OIL = 0.1387 MBTU

TABLE 11 (Con't.)
ESTIMATED ANNUAL ENERGY CONSUMPTION SUMMARY
FOR TARCOMSA OCCUPIED BUILDINGS AT SELFRIEGE ANG BASE

BUILDING DESCRIPTION	FLOOR AREA (SQ FT)	LIGHTING	ELECTRICITY (KWH) EQUIP.	COOLING	NATURAL GAS (KCF)	FUEL OIL (GAL)	STEAM (KBTU)	TOTAL ENERGY (MBTU)	ENERGY USE INDEX (KBTU PER SQ FT)
670 - RECREATION BUILDING	3239.	609.				2942.6		415.	128.2
673 - PUMP HOUSE	236.		1032.					47.	198.2
707 - CRIMINAL INVEST. OFF.	1836.	4968.	736.		482.2			563.	306.8
714 - THRIFT SHOP	1836.	6479.			322.5			418.	227.6
717 - EXCHANGE OFFICES	1543.	3680.	552.			1695.5		284.	184.2
720 - BASE EXCHANGE	9046.	7529.		39481.	2070.0			2679.	296.2
726 - SUPPLY STORAGE	4374.				416.9			430.	98.3
747 - BARBER SHOP	2750.	12607.			596.9			762.	277.0
750 - BARRACKS	9440.	9210.				7019.3		1080.	114.5
751 - COMMISSARY OFFICES	2650.	7360.	920.	15792.	105.1			388.	146.3
758 - BARRACKS	9440.							528.	56.0
781 - SERVICE STATION	3410.	1751.	2977.			3810.3		1492.	437.6
826 - BOWLING CENTER	8172.	21576.	9721.	31584.		10363.0		1458.	178.4
835 - COMMISSARY	10635.	35687.	3620.			5252.3		1378.	129.6
951 - CHILD CARE CENTER	3374.	9200.		38691.	476.0	6651.1		1046.	310.1
970 - ADMINISTRATION	32522.	38272.	11960.			20125.7		3374.	103.7
1492 - VEHICLE MAINTENANCE	29468.	72128.	27048.	52904.		34323.3		6525.	221.4

1 KWH ELECTRICITY = 0.0116 MBTU
1 KCF NATURAL GAS = 1.031 MBTU
1 GAL FUEL OIL = 0.1387 MBTU

TABLE 11 (Con't.)
ESTIMATED ANNUAL ENERGY CONSUMPTION SUMMARY
FOR TARCOMSA OCCUPIED BUILDINGS AT SELFRIIDGE ANG BASE

BUILDING DESCRIPTION	FLOOR AREA (SQ FT)	ELECTRICITY (KWH)		NATURAL GAS (KCF)	FUEL OIL (GAL)	STEAM (KBTU)	TOTAL ENERGY (MBTU)	ENERGY USE INDEX (KBTU PER SQ FT)
		LIGHTING	EQUIP. COOLING					
1493 - PUMP HOUSE	178.		81687.				948.	5323.4
1505 - WOOD SHOP	5958.	8096.	5520.		2907.1		561.	94.2
1506 - OFFICES	7806.	8096.	2944.		3560.6		591.	75.7
1515 - EDUCATION CENTER	9338.	12948.	4100.		4341.0		800.	85.7
1516 - OFFICES	7103.	8280.	2576.		5164.1		842.	118.6
1519 - BOILER HOUSE	1487.				3022.7		419.	281.9
1522 - WAREHOUSE	4571.	18980.			6084.9		1064.	232.8
1533 - VEHICLE GARAGE	2160.	1840.	2024.		4916.7		727.	336.5
1669 - GOLF CLUBHSE. STORAGE	2044.						0.	0.0
200 - 2 BEDROOM DUPLEX	1870.	7542.			1461.7		290.	155.2
200 - 3 BEDROOM DUPLEX	2948.	11851.			2013.9		417.	141.4
400 - 3 BEDROOM	2163.	8619.			1633.5		327.	151.0
509 - SINGLE FAMILY	1340.	5387.			1253.2		236.	176.3
700 - MULTI FAMILY	11472.	46328.			20853.4		3430.	299.0
900 - 2 BEDROOM	775.	3232.		52.7			92.	118.5
900 - 4 BEDROOM	1175.	4848.	*	75.5			134.	114.1
CAPEHART HOUSING	1255.	5387.	21121.				307.	245.0

* ELECTRIC HEATING

1 KWH ELECTRICITY = 0.0116 MBTU
1 KCF NATURAL GAS = 1.031 MBTU
1 GAL FUEL OIL = 0.1387 MBTU

in Table 11 on a building by building basis for those buildings under study. Total energy consumption was calculated for each building by converting all units to BTU's and summing them for each energy type. An energy usage index was then obtained for each building by dividing the total energy consumption by the gross floor area.

Summary of Recommended Projects

A brief description for each of the projects identified and evaluated under this Energy Engineering Analysis Program study is provided in Table 12. The funding requirements and energy and cost savings for each of these are summarized in Table 13. The projects presented in this table are listed in order of descending energy-to-cost ratios.

Implementation of all of the Increment A and F projects will require almost \$460,000 in funding and will yield a total annual energy savings of 19,650 MBTU. This energy savings figure is based upon each project being independent of the others and is exclusive of the effects of interactions between projects. Such effects would be negligible, as most interactions between ECOs have been accounted for within Project A-1.

Energy Goals and Projected Site Energy Usage

Historical energy consumption for Army occupied buildings at Selfridge is shown in Figure 5. The source of this information is the Army Energy Data Analysis, FY80 Update (Report No. FESA-T-2108) by Computer Sciences Corporation. The data shown in Figure 5 does not agree with the purchased energy data presented in Figure 3, but it does compare favorably with the annual energy consumption estimates made in Table 11.

According to the FESA report, FY75 energy consumption for Army buildings at Selfridge was 117,000 MBTU. In order to meet the goal of 25% reduction in energy consumption by FY85 compared to FY75 established by the Army Facilities

TABLE 12
DESCRIPTION OF EEAP GENERATED PROJECTS

Project	Description
A-1, Various ECOs for Army Buildings	<p>Various ECIP-qualifying ECOs identified under Increment A for Army buildings throughout the Base:</p> <ul style="list-style-type: none"> • Insulate Walls • Insulate Roof • Insulate Ceiling • Upgrade Window Systems • Weatherstrip and Caulk • Reduce Infil./Exfil. • Install Door Seals • Delamp • Timeclock Exhaust Fans • Reset Hot Water Temp. • Night Setback T-Stat. • Install TVR • Install DHW Controls • Install Spark Ignition • Install Flue Dampers • Insulate DHW Tanks
F-1, Special Application ECOs for Army Buildings	Those ECOs identified under Increment A as a result of the observation of special operational procedures or environmental conditions during field surveys (e.g., Supply Hot Water Heat From West Boiler, Building 1492).
F-2, Convert Street Lighting Systems to High Efficiency Lights	Convert street lighting in Army areas to high pressure sodium lamps.
F-3, ECOs for Building 310, Base Clinic	Various ECIP-qualifying mechanical and lighting ECOs.
G-1, Non-Qualifying ECOs for Army Buildings	Those ECOs identified under Increment A which do not meet ECIP criteria for E/C or B/C ratios.
G-2, Electric Submetering of Selected Buildings	Installation of electric consumption meters in Buildings 103/181, 104/747, 111, 112, 160, 162, 165/169, 168, 179, 300, 328, 334, 400, 599, 670/673, 707, 726, 751, 781, 826, 835, 951 and 970.
G-3, Steam Submetering of Selected Buildings	Installation of condensate meters in order to monitor steam consumption in Buildings 160, 162, 328 and 334.

TABLE 13

ENERGY ENGINEERING ANALYSIS PROGRAM
OMAHA DISTRICT CORPS OF ENGINEERS
SELFRIIDGE AIR NATIONAL GUARD BASE, MICHIGAN

SUMMARY OF PROJECTS

PROJECT TITLE	ANNUAL ENERGY SAVINGS					DOLLAR SAVINGS		COST		ECIP RATIOS		
	ELECT. (KWH)	NAT. GAS (KCF)	COAL (TONS)	FUEL OIL (GAL)	TOTAL (MBTU)	ANNUAL (FY86)	TOTAL BENEFIT	(CWE \$1000/S	TIC FY86)	E/C	B/C	SAP
<u>ECIP QUALIFYING PROJECTS:</u>												
ECIP PROJECT F-1, SPECIAL APPLICATION ECOS FOR ARMY BLDGS.	1690.	352.	0.0	27156.	4149.	71089.	931995.	61.8	64.8	67.2	14.4	0.9
ECIP PROJECT F-3, ECOS FOR BUILDING 310, BASE CLINIC	4508.	1195.	0.0	0.	1284.	9220.	141293.	23.5	24.7	54.6	5.7	2.6
ECIP PROJECT A-1, VARIOUS ECOS FOR ARMY BUILDINGS	71178.	2062.	22.1	70212.	13232.	196295.	3131102.	324.1	340.0	40.8	9.2	1.7
ECIP PROJECT F-2, CONVERT STREET LIGHTING SYSTEMS TO HIGH EFFICIENCY LIGHTS	84800.	0.	0.0	0.	984.	7363.	90400.	27.3	28.7	36.0	3.2	3.7
<u>NON ECIP QUALIFYING PROJECTS:</u>												
PROJECT G-1, NON QUALIFYING ECOS FOR ARMY BUILDINGS	22952.	954.	0.0	19232.	3918.	53976.	1095539.	575.0	603.2	6.8	1.8	10.7
PROJECT G-2, ELECTRIC SUBMETERING OF SELECTED BUILDINGS	0.	0.	0.0	0.	0.	0.	0.	39.9	39.9	0.0	0.0	NONE
PROJECT G-3, STEAM SUBMETERING OF SELECTED BUILDINGS	0.	0.	0.0	0.	0.	0.	0.	2.6	2.6	0.0	0.0	NONE

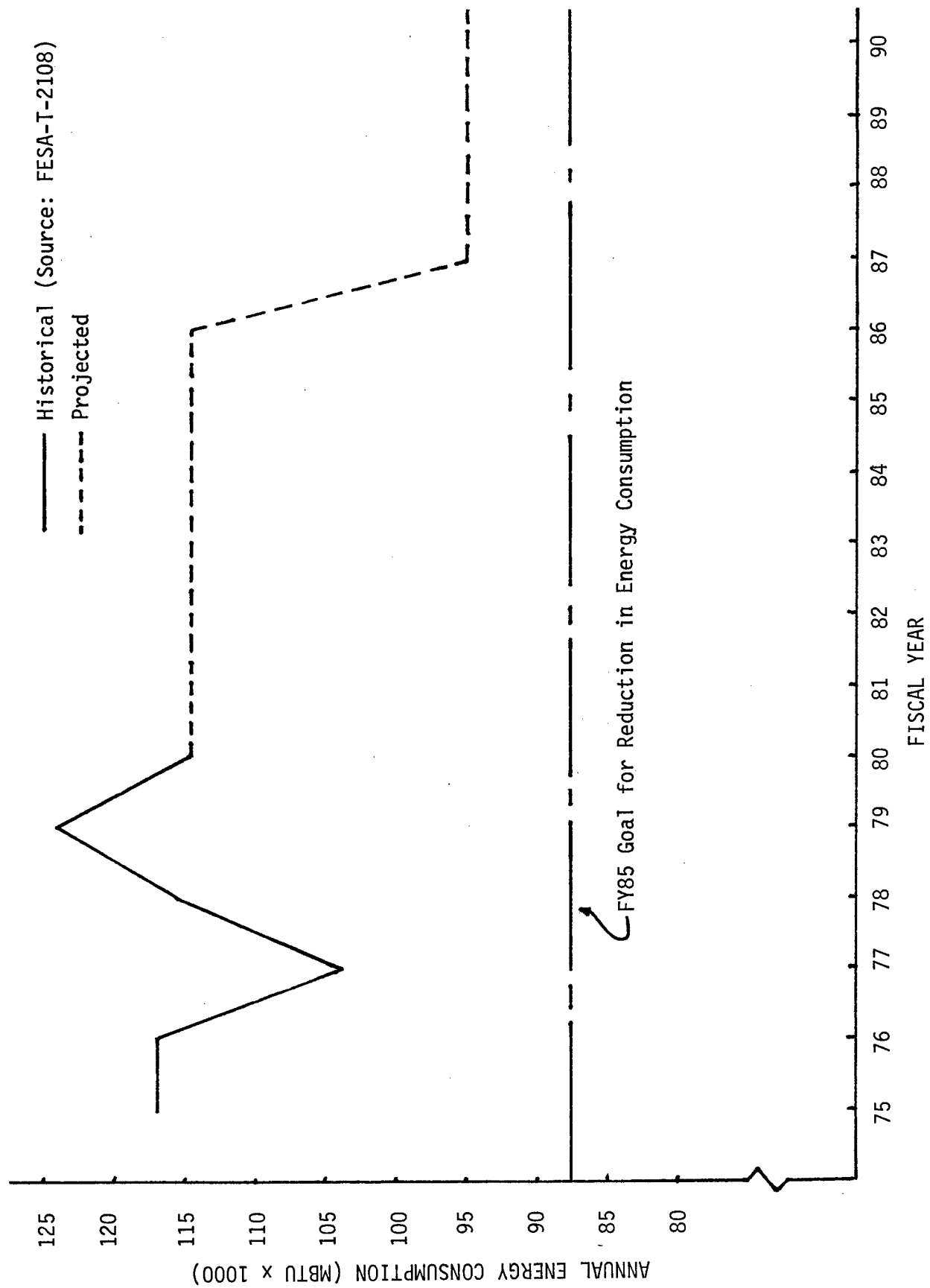


Figure 5 PROJECTED ENERGY CONSUMPTION FOR ARMY OCCUPIED BUILDINGS AT SELFBRIDGE AIR NATIONAL GUARD BASE

Energy Plan, the level of consumption must be reduced to 87,750 MBTU/YR by October 1984.

Implementation of the projects summarized in Table 13 appears to be the most promising alternative for achieving further reductions in energy consumption. Realization of the 19,650 MBTU/YR total savings for the projects which qualify for ECIP funding would reduce the Army's level of consumption at Selfridge from the present level of 114,710 MBTU/YR to 95,060 MBTU/YR, 7,310 MBTU/YR above the FY85 goal.

ECIP funding for the projects generated under this study will not be available until FY86. For this reason it appears that even if the Army generates an additional savings of 7,310 MBTU/YR by other means, Selfridge will be at least two years late in meeting its FY85 energy consumption goal.